REMARKS/ARGUMENTS

Claims 3-14 are pending in this application. By this Amendment, Applicants amend claims 3-6, 8 and 10-13 and cancel claim 1.

Applicants greatly appreciate the Examiner's indication that claims 9 and 14 are allowed and that claims 5 and 13 would be allowable if rewritten in independent form including all of the features of the base claim and any intervening claims.

Claim 1 was rejected under 35 U.S.C. § 102(b) as being anticipated by Kadota ("Combination of ZnO Film and Quartz to Realize Large Coupling Factor and Excellent Temperature Coefficient for the SAW Device" IEEE 1997 Ultrasonic Symposium). Applicants note that the Examiner has included only claim 1 in the description of the rejection over Kadota. However, in the body of the rejection, the Examiner has referred to claims 3, 4, 6-8 and 10-12. Accordingly, Applicants assume that the Examiner intended to reject claims 1, 3, 4, 6-8 and 10-12 over Kadota. Applicants respectfully traverse this rejection.

Claim 6 recites:

> "A surface acoustic wave device, comprising:
> a quartz substrate;
> a piezoelectric thin film disposed on said quartz substrate;
> comb electrodes disposed between said quartz substrate and said piezoelectric thin film; and
> **the normalized film thickness H/λ of said piezoelectric thin film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is H, and the wavelength of a surface acoustic wave is λ;**
> wherein
> **the Euler angles of said quartz substrate are within the range such that the temperature coefficient of frequency TCF of the surface acoustic wave device is within about ± 25 ppm/°C.**" (emphasis added)

The Examiner alleged that Kadota teaches each and every feature recited in Applicants' claimed invention, including "a piezoelectric thin film disposed on said quartz substrate" and "comb electrodes disposed between said quartz substrate and said piezoelectric thin film" <u>and</u> "the normalized film thickness H/λ of said pi zoelectric thin

film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is H, and the wavelength of a surface acoustic wave is λ" and a quartz substrate having Euler angles "within the range such that the temperature coefficient of frequency TCF (having a negative value) of the surface acoustic wave device is within about: +25 ppm/°C, ± 5 ppm/°C." The Examiner refers to pages 261-266 of Kadota as allegedly teaching these features. However, the Examiner has failed to specifically refer to any particularly disclosure or figure that allegedly teaches this feature. Applicants respectfully disagree with the Examiner's allegation that Kadota teaches the above-noted features.

In contrast to the present claimed invention and the Examiner's allegations, Fig. 3 of Kadota (a marked-up copy is attached hereto) shows the thickness dependencies of a calculated electromechanical coupling factor for surface acoustic wave devices having various configurations. However, as clearly shown in Fig. 3 of Kadota, the only device (marked with an arrow) which includes "a piezoelectric thin film disposed on said quartz substrate" and "**comb electrodes disposed between said quartz substrate and said piezoelectric thin film**" (emphasis added) as recited in Applicants' claimed invention, has a normalized film thickness H/λ that is between 0.00 and approximately 0.13, **NOT** a normalized film thickness H/λ that is **at least 0.20** as recited in the present claimed invention.

It appears that the Examiner has relied upon the first paragraph on page 263 of Kadota to allegedly teach a normalized film thickness H/λ that is at least 0.20. However, this paragraph discloses that "in the case of (a) IDT/ZnO/Quartz or (c) IDT/ZnO/shorted-plane/quartz, a large Rayleigh SAW coupling factor is indicated in the range of H/λ ≥ 0.2 . . . However, the coupling factor on a Rayleigh SAW on (b) ZnO/IDT/quartz is very small . . ." Since the present claimed invention recites "a piezoelectric thin film disposed on said quartz substrate" and "comb electrodes disposed between said quartz substrate and said piezoelectric thin film" corresponds to the ZnO/IDT/quartz SAW device, **NOT** a thin film that is disposed between a comb el ctrod s and a quartz

substrate, e.g. IDT/ZnO/Quartz or an IDT/ZnO/shorted-plane/quartz, Kadota clearly fails to teach or suggest a normalized film thickness H/λ that is at least 0.20 for a SAW device that includes "a piezoelectric thin film disposed on said quartz substrate" and "comb electrodes disposed between said quartz substrate and said piezoelectric thin film" as recited in the present claimed invention.

In fact, Kadota clearly teaches away from a SAW device which includes "a piezoelectric thin film disposed on said quartz substrate" and "comb electrodes disposed between said quartz substrate and said piezoelectric thin film" **and** "the normalized film thickness H/λ of said piezoelectric thin film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is H, and the wavelength of a surface acoustic wave is λ" as recited in Applicants' claimed invention because Fig. 3 of Kadota specifically teaches that a SAW device which includes comb electrodes disposed between a quartz substrate and a piezoelectric thin film (e.g., ZnO/IDT/Quartz) cannot have a normalized film thickness H/λ that is greater than approximate 0.13.

Thus, not only does Kadota fail to teach or suggest each and every element recited in claim 6 of the present application, but Kadota also cannot be relied upon in an obviousness rejection of Applicants' claimed invention since it is error to find obviousness where references diverge and teach away from the invention at hand. W.L. Gore & Assoc. v. Garlock Inc., 721 F .2d 1540, 1550, 220 USPQ 303, 311 (Fed. Cir. 1983).

Since Kadota clearly fails to teach or suggest a SAW device which includes "a piezoelectric thin film disposed on said quartz substrate" and "comb electrodes disposed between said quartz substrate and said piezoelectric thin film" **and** "the normalized film thickness H/λ of said piezoelectric thin film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is H, and the wavelength of a surface acoustic wave is λ," Kadota certainly fails to teach or suggest "the Euler angles of said quartz substrate are within the range such that the t mperature coeffici nt of

frequency TCF of the surface acoustic wave device is within about ± 25 ppm/°C" in combination with the features recited above, as recited in Applicants' claimed invention.

Accordingly, Applicants respectfully submit that Kadota fails to teach or suggest the unique combination and arrangement of method steps and features recited in claim 6 of the present application.

In view of the foregoing amendments and remarks, Applicant respectfully submits that Claim 6 is allowable. Claims 3-5, 7, 8 and 10-13 depend upon claim 6, and are therefore allowable for at least the reasons that claim 6 is allowable. Claims 9 and 14 are allowed as indicated by the Examiner.

In view of the foregoing amendments and remarks, Applicant respectfully submits that this application is in condition for allowance. Favorable consideration and prompt allowance are solicited.

The Commissioner is authorized to charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-1353.

Respectfully submitted,

Date: February 5, 2004

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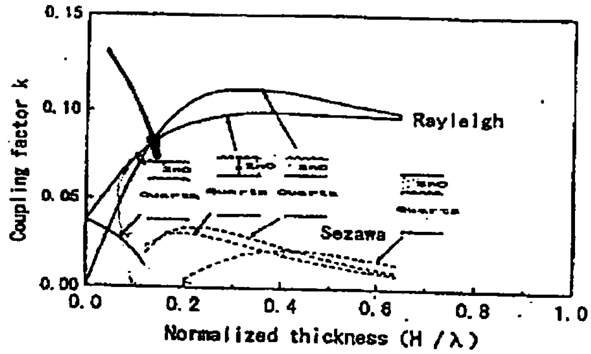

Fig. 3. ZnO thickness dependence of calculated electromechanical coupling factor(solid line: Rayleigh SAW, broken line: Sezawa SAW).

IV. Experimental Results of Velocity and Coupling Factor

After deposition of a ZnO film to a thickness of 4.5~7 μm on the 29°45'rot.Y and 42°45'rot.Y quartz substrates by an RF magnetron mode electron cyclotron resonance (RF-MG-ECR) or a conventional RF magnetron (Con. RF-MG.) sputtering system, aluminum IDTs were formed on the ZnO film by a liftoff method to provide the above-mentioned structure of (a)IDT/ZnO/quartz. A SAW filter consists of two normal-type IDTs having 20 pairs having various wavelengths of 13~72μm. It was found from X-ray diffraction analysis that the ZnO film formed on these quartzes was a poly-crystal c-axis oriented film.

dependence of the velocity and the electromechanical coupling factor on ZnO film thickness are shown in Figs. 4 and 5. In both figures, theoretical values for the ZnO on the 29°45'rot.Y35°X and 42°45'rot.Y35°X quartz substrates are shown by solid lines and broken lines respectively. Measured values for ZnO/29°45'rot.Y and 42°45'rot.Y quartz substrates deposited by the RF-Mg-ECR sputtering systems are plotted as o and • and those deposited by the Con. RF-MG. sputtering systems as × and +, respectively. In these figures, the measurement results are only Rayleigh SAWs. Though Sezawa SAWs exists theoretically, no generation of Sezawa SAWs could be observed because of their small coupling factor. A slight difference was observed with respect to the velocity of the thin ZnO film deposited by the RF-MG-ECR between the theoretical values and the experimental values ; however, with respect to the other velocities and the coupling factors, these values agreed well. In the range of ZnO film thickness H/λ from 0.2 to 1.0, large values of electromechanical coupling factors (0.1~0.11) are obtained which are identical to the theoretical values. The coupling factor values of the 29°45'rot.Y plate and the 42°45'rot.Y plate are almost identical, both experimentally and theoretically. The structure of (c)IDT/ZnO/shorted-plane/quartz also is considered to be able to provide a large value approximately identical to the theoretical value as in the case of the structure of (a)IDT/ZnO/quartz. Where the SAW velocity was obtained from the center frequency of the SAW filter and the wavelength. The electromechanical coupling factor was determined by measurement of a radiation conductance of a motional conductance circle of the above-mentioned normal IDT [5], [16], [17], [18]. Residual inductance in the measurement (for example, generated from a measuring jig or a sample) affects the measured motional conductance. As residual inductance in the measurement increases, the motional conductance circle moves away from the susceptance axis, its trajectory becomes tilted, and the motional conductance becomes large [5], [16], [17]. It is necessary to measure the radiation conductance under the condition of minimum residual inductance for accurate coupling factor determination [5], [16], [17]. It is possible to evaluate a accuracy in the measurement from the tilt of the trajectory of the motional circle.

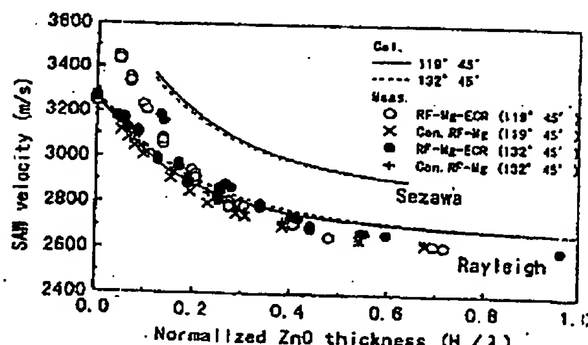

Fig. 4. SAW velocity relative to ZnO thickness.

V. Experimental Results of TCF

The center frequencies of the SAW filters were measured at temperatures from −20 to 80°C. The results for a SAW filter on IDT/ZnO/29°45'rot.Y35°X quartz are indicated for a ZnO thickness H/λ≐0~0.54 in Fig. 6 as a function of temperature. In this figure, the ZnO films were deposited by the Conventional RF-MG. sputtering system. Measured values of the TCF in the absence of a ZnO film are plotted as o. Measured values for ZnO film thicknesses $H/\lambda = 0.10, 0.29, 0.38$ and 0.54 are indicated by △, ×, • and o, respectively. It is clear that as a result of deposition of the ZnO with a negative TCF on the quartz having a positive TCF,